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ABSTRACT

Requirements for vocational skills in the engineering industry in Modena, Italy, and Vienna, Austria, were studied. In Modena, employees of a representative sample of 90 small, medium, and large firms in the mechanical processing, agricultural machinery, and sports car manufacturing sectors were interviewed. In Vienna, data were collected through 8 case studies and interviews with 14 industry experts and national-level educational officials, 30 human resource management experts in 25 firms, and 20 individuals responsible for technical areas in representative firms. In 1991-1995, the size of Vienna's engineering production and car manufacturing sector decreased sharply (from 1,080 firms employing 25,822 individuals to 145 firms employing 12,130 individuals). In Modena, the sector shrank only slightly (from 154 firms employing 8,447 individuals to 136 firms employing 8,104 individuals). The following trends characterized Vienna's engineering production and car manufacturing industry: development of problem solving; increase in worker responsibilities and level of skills required; greater production orientation; emphasis on formalized knowledge versus experience; and acquisition of a globalization strategy. In Modena, the following trends were noted: flexible specialization; management of innovative function areas and integrated processes; emphasis on discovery, multifunctionality, and problem solving; rise in technical and specialist knowledge; and greater quality orientation. (Contains 27 tables) (MN)

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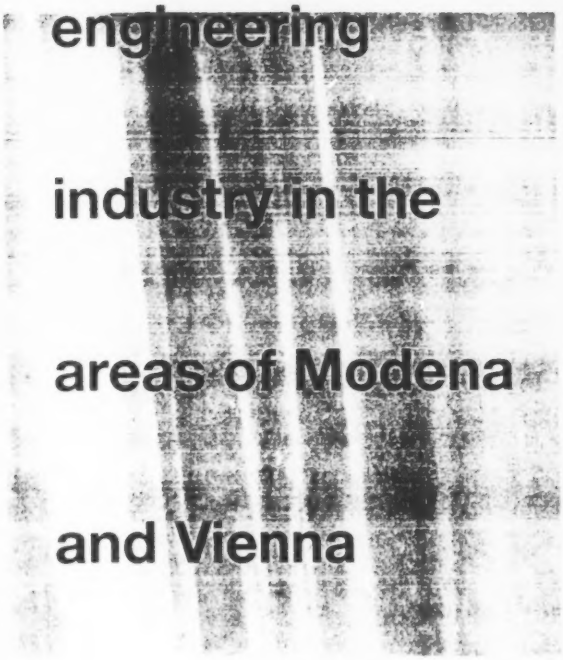

European Centre for the Development of Vocational Training

Synthesis report

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The requirement for vocational skills in the engineering industry in the areas of Modena and Vienna

Synthesis report

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May 1998

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Foreword by Cedefop

As part of the initiatives promoted by Ciretoq - the Network on trends in occupations and qualifications - extensive efforts have been devoted to the analysis and prediction of occupational requirements and the dynamics of job skills. As the promoter of the network, Cedefop has proposed that it set up three work groups:

- Group A, for the formulation of mainly quantitative macro-economic analysis projects;
- Group B, for the formulation of mainly qualitative socio-economic analysis projects;
- Group C, for the formulation of competence analysis projects taking the sectorial approach.

Following discussions within Group B, whose members include Isfol (Istituto per lo Sviluppo della Formazione professionale dei Lavoratori) and its Austrian partner IWI (Industriewissenschaftliches Institut an der Wirtschaftsuniversität Wien), the two research institutes proposed a joint project: the coordinated conducting of two local surveys analysing the vocational requirements in the engineering sector.

In view of the diversity of the environments selected - Modena and Vienna - and the differences between the regulatory framework - national and local - as well as the different levels of funding allocated to the two surveys, it was decided to pursue different objectives in each local situation.

The Viennese survey conducted by IWI was designed to study changes in occupations occurring across the engineering industry. The findings provide a useful reference for updating training and educational curricula and for the alignment of skills acquired at school and in training. The main user of the findings, therefore, is the school and training system.

The Commune of Modena, which has a direct concern in obtaining the survey findings and in their immediate use in preparing training policies, decided of its own accord to made a significant financial contribution to the research. This meant that the survey could be extended to the acquisition of quantitative data. The objective of the research conducted in Modena was twofold:

- to identify the occupational profiles most in demand on the labour market and interpret the (quantitative) trends in employment;
- to analyse changes, current and future, in the occupational profiles.

The users of the findings are the political decision-makers responsible for management of the labour market and the planning of training, including those aspects of the vocational training system relating to guidance and updating the provision of training.

The methodological approaches, techniques and instruments adopted for the survey and analysis of occupational requirements in the two projects were developed in the light of the specific objectives pursued in each survey and the demand for information from the target users of the findings. Although the surveys differed, the two work groups coordinated the implementation of the surveys, i.e. the phases, implementation time and the timing of exchange and interaction.

This study was commissioned by Cedefop, in collaboration with IWI (Industriewissenschaftliches Institut an der Wirtschaftsuniversität Wien) and ISFOL (Istituto per lo Sviluppo della Formazione professionale dei Lavoratori), and conducted by the following working group:

- Ludovica Cottica, Giovanni Ghiotto, Giorgio Onesti and Tiziana Osio, for the survey conducted in the Modena area;
- Jörg Markowitsch and Robert Neuberger, for the survey conducted in the Vienna area;
- Mario Gatti, Maria Grazia Mereu and Claudio Tagliaferro, who were responsible for the technical and scientific coordination of the study and who drew up the synthesis report.

Mara Brugia
Project Coordinator

Stavros Stavrou
Deputy Director

Part I

Specific nature of the objectives, scopes and models in the two national surveys

1. The occupations required in the engineering industry: the Modena area

1.1 The survey objectives and scope

The main purpose of the survey conducted in Modena was to determine the trends in the engineering industry in the area of Modena, with specific reference to three branches: mechanical processing, agricultural machinery and tractors, and sports cars.

The assumption was that the occupations required were determined by various factors associated with trends in the sector, including in particular innovations in the field of production technologies, changes in company management and inter-company relations, and the diversification and expansion of markets.

It was decided to relate employers' attitudes towards the requirement for occupations to the main data acquired on trends in the environment in which companies in the sector and their markets operate.

The objectives and scope of the survey meant that the methodological approach adopted had to allow for the acquisition of more specific and detailed data, not just on job titles but also on the content of those jobs that were found to be in demand to a certain extent. In other words, the information obtained should be more detailed than in a general investigation of the situation: there should be targeted questioning of people working in the production system.

1.2 The survey model and procedures

In connection with the above, it would be helpful to define certain concepts relating to the subject of the survey: the requirement for vocational skills ('*professionalità*') and occupations. The first term is usually associated with the idea of competence or skills, so the term 'vocational skills' can be regarded as synonymous with 'vocational competence' ('*competenza professionale*'). By this term is meant the body of knowledge, cognitive and procedural aptitudes, social and interpersonal skills that enable an employee to plan and implement organisational and working behaviour appropriate to the context.

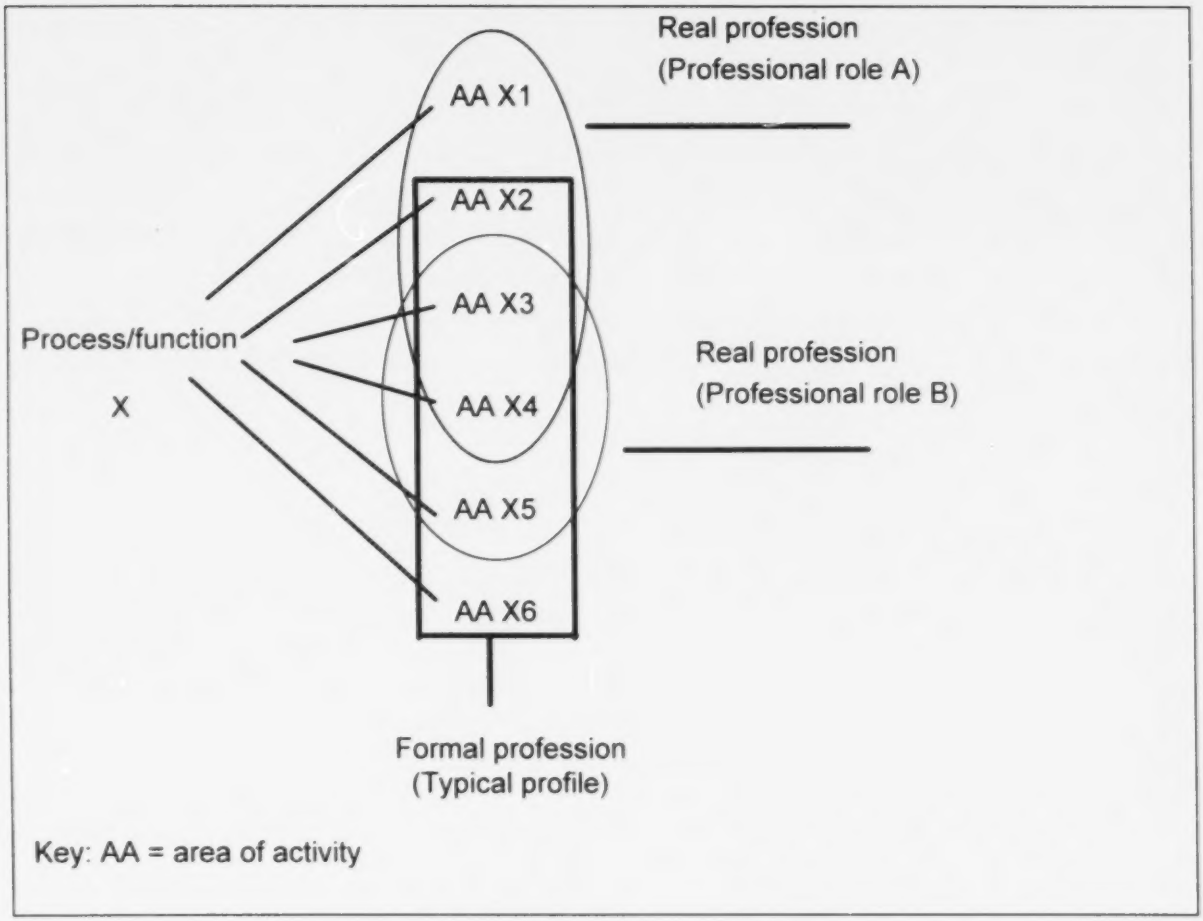
Vocational competence is thus based on three factors: the individual's own resources, the specific nature of the tasks to be performed and the nature of the context in which the

tasks are performed and the competence exercised. Because of the specific contexts in the different production structures, there is a need to draw, as an analytical tool, a distinction between '*real occupations*' and '*formal occupations*'. The former define and describe what, in practical terms, is required of an employee in a given organisational context in terms of job performance. In this sense, the term is close to that of 'occupational role'. Formal occupations are the ideals or standards used as a yardstick for the purpose of certification or training or social recognition. The common factor in formal and real occupations may be that the different occupational roles must perform and predominate in the same production process or in a specific segment of that process. It should not be forgotten, however, that the purpose of the survey is to determine what the 'real and actual' requirement for occupations is among firms in the sector. For this reason, the subject of the survey should be identified as not the 'formal'-type occupations but rather the 'real' occupations, i.e. the vocational roles actually performed in the workplace.

A role is performed in one's own occupation within a production process (or segment) by operating in different 'activity areas' (AAs) depending on the organisational arrangement within the workplace. By the term 'activity area' is meant a set or cluster of homogeneous, integrated tasks that refer to one process segment, or one phase of that segment. If this meaning is adopted, the activity area is the operational nucleus identified by the convergence of the following elements:

- a set of homogeneous tasks relating to a sub-process or process phase;
- a set of homogenous functions or sub-functions connected with those tasks;
- a body of knowledge and occupational competences needed to performe the tasks and functions identified.

Table 1: Activity areas as an element linking a real and a formal occupation



As indicated in the above diagram, the heuristic instrument that allows a formal occupation to be connected to real occupations is the concept of 'activity area'. Indeed, the structure of the standard profile includes the most common and widespread activity areas in the roles performed in the various production situations.

The path taken essentially consisted of two phases:

a) People from a significant sample of companies operating in the sector were interviewed, and the following determined:

   - whether activity areas relating to processes and functions typical of the sector are present in the company, and the level of development and strategic importance that the company attaches to each one;
   - what occupational roles are required by the companies (in our case we stress the roles that, because of their 'depth' of competence and degree of importance in the

company's development management, are located at the technical/specialist and/or management levels);

- the activity areas in which those roles are performed and the essential skills that an individual must possess (on this point, further detail was obtained by semi-structured interviews of a smaller sample of experts and significant interviewees).

b) The next step was to take the information obtained from a questionnaire submitted to the sample companies, and determine the similarities that could be used to convert the many real occupations into a smaller number of formal occupations (grouped by types of activity areas and by skills), identifying the corresponding categories of typical job profiles.

The sample consisted of 90 companies, chosen on the basis of two criteria:

- the branch to which they belong (mechanical processing, agricultural machinery, sports cars)
- the size of the company (1 to 50 employees, 51 to 100, over 100 employees).

The variables taken into account in defining the sample, apart from those relating to the branches of the sector and size of company, were:

- production characteristics, the breakdown being:
  - production mainly on one's own account (OP)
  - production for third parties (TPP)
  - partly own production, partly for third parties (OP/TPP)
- the percentage of production exported, the breakdown being:
  - to 20%
  - to 50%
  - to 80%;
  - to 100%.

2. Trends in occupations in the engineering industry: the Vienna area

2.1 The survey objectives and scope

The main purpose of the survey conducted in the city of Vienna and its surroundings was to describe future occupations in the engineering industry in order to support the planning and design of the secondary education and continuing training system, by providing information on the vocational activities expected over the short and medium term.

Starting with secondary school vocational education – and in Austria the social partners are involved in its planning - the first level of investigation gave an understanding of the socio-economic background to the industry.

2.2 The survey model and procedures

In order to identify the changes affecting qualifications, a structured qualitative survey was conducted, taking the top-down approach: evaluating developments in qualifications in the engineering industry. The questionnaire was designed so that it could be used to refine the findings in regular subsequent cycles. This incremental approach offered three advantages in describing the situation in Vienna:

- in each cycle of interviews, the findings can be incorporated in attempting to determine the skills required, gradually improving those findings by successive approximations;
- the information obtained on the changing patterns of skills does not call for investigation into the environments of the engineering production system in which the changes occur, so that the field-study phase in the workplace can be circumvented;
- the interviewers themselves become experts by helping to explore the possible skills and understanding the key requirements step by step.

The survey was broken down into four separate, sequential parts:

1. Interviews with engineering industry and car manufacturing experts and with national-level education officials.
2. Interviews with experts in human resource management in representative engineering firms.
3. Interviews with those responsible for technical areas in representative firms.
4. Validation of the interview findings through case studies.

This procedure is similar to the Delphi method except that in the latter, which is based on feedback from experts regarding their previously expressed views; the opinions expressed at the previous level are validated by experts whose level of specialisation differs each time.
The aim is to examine closely the trends and growth potential identified by the experts at general level with decision-makers in companies.

In the first phase (interviews with national experts) interviews were held with 14 people in senior positions in the following fields:

- continuing training
- social partners
- representatives of industrial associations
- consultants on the installation and relocation of firms in the Vienna area
- research and development managers from representative firms.

A structured but open-ended questionnaire was used as an interview tool, as it would be more flexible in use during the interview. The questionnaire items covered the following three issues:

1. current technological and economic changes in the engineering industry;
2. the problems of and potential for growth in occupational activities and competences of people with technical or vocational training;
3. the strengths and weaknesses of the existing system of secondary technical and vocational training.

The second part of the research consisted of interviews with the human resource managers and those responsible for technical areas in the workplace. Seventy-five firms were contacted. The sample was whittled down by discarding firms that no longer had a production unit in Vienna. Thirty interviews were then conducted at 25 firms. Given the predominance of large companies operating in the Vienna engineering industry, the companies contacted had a total workforce of about 9 500. Every 10 interviews, the main trends identified, particularly what appeared to be contradictory aspects, were presented and discussed with the next set of 10 interviewees.

In the course of the 20 last interviews conducted in the workplace, the production units of eight engineering firms were visited. The purpose was to identify and validate, in relation to current production arrangements, the trends ascertained through the interview with managers.

Part II

The findings of the two national surveys

3. Introduction to the Modena case

The most common industrial model in Emilia Romagna and the Modena area is one of 'flexible specialisation', with small and medium-sized firms tending to come together and form industrial zones, each firm retaining its own internal structure but focusing on a specific sub-sector. The Modena province is one of the most dynamic and productive in Emilia Romagna, and firms are very much geared to exports.

In the late 1980s and early 1990s, the Modena engineering industry went through a period of crisis, leading to restructuring and rationalisation which in turn substantially reduced employment. In 1994, companies in the engineering industry accounted for about 22% of the total number of companies in Modena industry and employed about 34% of the total workforce. When the firms in the industry were surveyed in late 1995, about 2 600 were recorded, with a total workforce of 42 000 and an average workforce of about 16 per company. Based on the figures available for 1996 (only for the Commune of Modena, in which 50% of the companies in the Region are located), certain conclusions can be drawn about the nature of the workforces in terms of the types of work and age groups. The proportion in the youngest age group, 15 to 29, is relatively low compared with the older groups. The working population seems to be gradually ageing. Entrepreneurs in Modena attribute the difficulty in recruiting younger workers, at least in part, to the fact that the industry has little attraction for young people. The labour shortages are felt especially in two areas: graduates and highly skilled professionals, and people with low levels of education and low levels of skills. The largest occupational groups, those that employers can find most readily, are the intermediate levels and those engaged on skilled tasks.

3.1 The degree of development of Activity Areas (AAs)

An activity area is a survey context that can be used as a basis for analysing the requirement for skills and occupations in the light of 'objective' data relating to the organisational arrangements in the production structures. Function areas and AAs are the working contexts that can be used to reconstruct the different occupational roles actually performed in the workplace and then, as a first step, infer the vocational content of those roles.

The methods used by the interviewees to evaluate the degree of development of the AAs were an indication of the structural factors on which their demand for occupations and competences was based.
The function areas investigated, within which the AAs were identified, were:

Table 2: Activity Areas present in the function areas.

2.1	ACTIVITY AREAS IN PRODUCTION MANAGEMENT		
1.1	Feasibility study on new products	1.9	Production planning
1.2	Design of modifications to existing products	1.10	Tooling and tool preparation
1.3	Production of technical documentation	1.11	Machine tools processing
1.4	Plant engineering	1.12	Hot processing
1.5	Production engineering	1.13	Cold processing
1.6	Determination of processing cycles	1.14	Assembly, fitting
1.7	Maintenance planning	1.15	Grinding, finishing
1.8	Definition of software structure	1.16	Routine maintenance
		1.17	Repairs

2.2	ACTIVITY AREAS IN QUALITY CONTROL
2.1	Design
2.2	Planning
2.3	Management
2.4	System audit
2.5	Data control audit

2.3	ACTIVITY AREAS IN LOGISTIC MANAGEMENT
3.1	Procurement management for incoming goods
3.2	Stock management
3.3	Supplies planning
3.4	Management of outgoing goods
3.5	Despatch management
3.6	Industrial waste management

2.4	ACTIVITY AREAS IN COMMERCIAL MANAGEMENT
4.1	Sales planning
4.2	Sales promotion
4.3	Sales management audit
4.4	Distribution
4.5	Market development
4.6	After-sales service

The factors used in analysing the AAs were:

A. the degree to which individual AAs are present in firms. This factor is used to determine whether human resources operating within the firm are used in tne Activity Area or whether, to profit from the outputs of that area, the firm prefers to call on outside consultancies. This finding is of interest as it may indicate the scope for growth for both employees and the self-employed;

B. the relative current and future Strategic Values of the AAs are an indicator of the 'weight' of individual AAs in company expansion plans. It may be assumed that strategic AAs are those which, in a company's planning, are seen as the vital operational contexts when tackling the problems of improving productivity and ensuring success on the market. The current Strategic Value, and even more so the future Strategic Value, of an AA is significant in determining the need for skills, since there will almost certainly be a greater demand in the near future for human resources having appropriate vocational skills for those working contexts;

C. the outlook for workforce expansion in the AAs studied.

In short, it was felt appropriate to suggest an analytical model which could be used to identify three types of AAs: successful AAs; AAs expanding in the market; and 'bought-in' AAs. The tables below, one for each type of AA, set out the percentage for the four factors described above (presence of AAs, their strategic value, future value, workforce expansion).

1. Successful AAs are those in which the percentages of each of the factors taken into account are relatively high. The AAs in this group offer substantial guarantees on the jobs market, because they are widespread in production contexts, or because workforce growth is planned, or because their strategic value is growing.

Table 3: Successful Activity Areas (AAs)

AAs	CP	CS	SF	EW
2.2 Quality system planning	54.4	57.8	87.7	35.1
4.2 Sales promotion	66.7	58.3	80.0	35.0
4.5 Market development	70.0	73.4	93.7	34.4
1.2 Design of modifications to existing products	87.7	64.5	83.5	29.1
2.4 Quality system audit	50.0	50.9	87.3	29.1
2.1 Quality system design	34.4	56.4	87.2	23.0
1.1 New products feasibility study	23.3	62.6	76.0	25.3
4.6 After sales services	84.4	52.6	69.7	25.0

Legend

CP = Currently Present
CS = Currently Strategic
SF = Strategic in Future
EW = Expanding Workforce

2. Expanding AAs are characterised by their solid spread and expansion, even though their strategic value may not be high. These are operational contexts whose market is guaranteed even though they are not 'strong points' in the company's strategy.

Table 4: Expanding Activity Areas (AAs)

AAs	CP	CS	SF	EW
1.10 Equipment	84.4	19.7	36.8	34.2
1.14 Assembly, erection	97.8	32.9	34.1	34.1
1.11 Numerically controlled machine tool processing	82.2	27.0	39.2	33.8
1.4 Plant engineering	53.3	41.6	60.4	29.1
2.5 Data control logging	76.6	38.9	63.6	29.9
1.5 Production engineering	67.7	50.8	63.9	27.9
3.1 Incoming goods order management	96.6	26.4	44.8	25.3

Legend

CP = Currently Present
CS = Currently Strategic
SF = Strategic in Future
EW = Expanding Workforce

3. 'Bought in' AAs are not substantially present in the workplaces, in that a significant percentage are procured from outside. This is a type of activity that covers occupations not so much in the context of an employee as in services rendered to firms. Table 5 shows the characteristics of the AAs included in this type.

Table 5: 'Bought in' Activity Areas (AAs)

AAs	CP	BI	FP	EW	FS
1.8 Definition of software structure	35.5	52.2	1.1	9.3	87.5
2.1 Quality system design	34.4	34.4	8.9	23.0	87.2
2.4 Quality systems audit	50.0	22.2	11.2	29.1	87.3
2.2 Quality systems planning	54.4	21.1	8.9	35.1	87.7
4.4 Commercial distribution	58.9	13.3	1.1	5.5	38.9
1.4 Plant engineering	53.3	10.0	-	29.1	60.4
1.15 Grinding and finishing	60.0	10.0	-	20.4	24.1

Note: AAs 2.1, 2.4 and 2.2 have been included in the table for 'successful AAs'.

Legend
CP = Currently Present
BI = Bought-in
FP = Future Presence planned
EW = Expanding Workforce
FS = Future Strategic value

3.2 The demand for vocational skills and competences

In research economics the concept of a human resource employed in an organisation is like that of an occupational role, in the sense of 'what an employee does in a given context, in relation to given roles, to achieve given objectives'.

Since occupational roles exist as part of practical organisational models that differ according to the variables involved, the profiles and even names of those roles may not always be comparable. This creates a risk of ambiguity in reporting the requirements for occupational skills. The use of Activity Areas as a diagnostic tool has proved very effective in averting this risk. Here reference is made not so much to the names of roles but to the procedures whereby, under various names, comparable functional and operational contexts are aggregated in a reasonably homogeneous manner.

In this way, the profiles of the occupations most in demand from the production structures are constructed from the bottom up: by analysing the work content of the individual roles demanded, and so structuring the occupations that are in demand.
Before going on to describe the findings for the demand for skilled workers, it may be helpful to look at the overall picture of the workers in firms to whom the interviewees attributed strategic value.

Table 6 shows percentages calculated from the number of times the workers were mentioned compared with the total for the sample.

Table 6: Strategic workers present in the sample

Worker	% of the total sample
Quality systems manager	56
Stock manager	38
Design engineer	35
Marketing manager	33
Marketing engineer and sales promoter	32
Process and product manager	27
Quality control engineer	25
Production planner	25
After-sales support engineer	24
Goods control manager	21
Logistics manager	18
Technical office manager	19
Logistics engineer	16
Exports manager	14
Installer/assembler	14
Branch (or workshop) manager	14
NCMT programming engineer	10
Fitter/tester	9
Product manager	7
Orders manager	7
Tooling engineer	6
Stock movements controller	4
NCMT operator	4
Domestic sales manager	3
Software engineer	3
Mechatronics engineer	2
Finance and audit manager	2
Maintenance engineer	1
Research and development manager	1
Prototype engineer	1
Information system engineer	1

The strategic value of a practitioner is not simply an indicator of the 'requirement' for human resources able to perform that worker's normal tasks. Those workers who the interviewees felt were the focus of demand are listed in the Table 7 below, which includes:

- the name of the worker required;
- the percentage requirement (i.e., the number of firms requiring such workers, compared with the total sample) over two different time scales: the next two years, and the next five years;
- the nature of the firms expressing the requirement, expressed as two variables:
  - size of the firm
  - type of product (whether for its own market, for third parties or both).

Table 7: Workers in greatest demand, in order of strategic value

Workers	**Requirement over period of:**		**Nature of firm**	
	two years	**five years**	**Size (workforce)**	**type of market for products**
Sales promoter	29%	8%	almost all: over 40	almost all with own market (exports account for average of over 40%)
Fitter/assembly engineer	26%	2%	over 30	two thirds with own market
Design engineer	26%	-	over 30	not an influential factor
Production engineer	25%	9%	almost all: over 50	not an influential factor
Production planner	25%	9%	over 30	not an influential factor
Branch or orders manager	20%	9%	almost all: over 40	(exports account for average of over 30%)
Quality systems manager	15%	6%	over 40	not an influential factor
Quality control engineer	15%	3%	workforce of over 50	all with own market and partly for third parties
After-sales support manager	15%	3%	two thirds: over 50	(exports account for average of over 30%)
Logistics management engineer	8%	-	workforce of over 30	with own market and partly for third parties

All the interviewees provided information on the current demand for skills and practitioners, but few could predict the trends affecting competences over the next few years, for various reasons. First was the fact that occupations are constantly evolving, but so gradually that the changes may not be noticed even by the people directly concerned.

Secondly, only a few of those who work day to day in production structures can predict which of the innovations (in technologies, products, markets and regulations) may entail rethinking the distribution of tasks and duties and the content of vocational knowledge. The relative 'newness' of an element of vocational competence as reported by the interviewees depended a good deal on the 'history' of the company to which they belonged. Some people saw a given element of a competence as 'new' because the technological or organisational change embodying that competence had only recently been introduced into their companies; others, on the contrary, saw the same change as now being firmly established.

In the interviewees' vocabulary, the concept of competence was synonymous with 'performance'. On the one hand the focus is on procedural skill backed by reasonable familiarity with technical and scientific concepts. On the other, it is on the abilities deployed by the worker in formulating and solving tasks and problems, with due regard to the context and personal relationships (in other words, cognitive, social and interpersonal skills).

The different spheres of competence analysed for the various practitioners may be placed in seven categories:

A. Knowledge of the materials being processed and the products. This is a sphere of competence of concern to all those employed in function areas of production, quality control and logistics. It is also considered as a corpus of skills for those operating in the commercial area.

B. Knowledge and abilities pertaining to the implementation of procedures. It is the sphere of competence attributed to roles entailing technical and specialist functions and relates to the ability to tackle unforeseen problems. It is linked in particular with the ability to 'diagnose' the context of a task and to plan and practise good vocational behaviour, as well as with flexibility and the ability to take an overall, integrated view of problems.

C. Knowledge and abilities pertaining to the strategic planning of a function area (or part of that area). This sphere of competence is attributed in particular to roles with managerial functions, for which the term 'manager' has been used (production manager, orders manager, quality systems manager, etc.). It indicates above all the ability to combine different types of resources with a view to performing a project. It also indicates knowledge and abilities associated with both the technical variables and human resources and taking the client into account, as a prerequisite in drawing up strategic plans for management and development.

D. Knowledge that can be used to interact with various functions - a sphere of competence associated with vocational roles having a technical-specialist function,

operating on the 'frontier' between different processes. It represents a corpus of knowledge about techniques and terminology that can be used to interact with two or more function areas. An integral part of this sphere is that of interpersonal skills and a flexible approach.

E. Knowledge of quality and safety regulations and procedures. These competences are commonly attributed to all those roles at a medium-to-high level with specific skills associated with the post.

F. Knowledge of foreign languages. This is a sphere of competence attributed in particular to posts whose holders work with foreign colleagues and customers.

G. Interpersonal competences. There are two dimensions to this sphere of competence: management of internal communications, and management of external communications.

3.3 Content of the competence required for what are regarded as strategic occupational roles

In general the competence/knowledge associated with all the function areas analysed call for a medium-to-high level mastery of procedural expertise.

The first column of the tables below lists the types of competence reported. The second column lists the occupational roles for which the competences are required.

It should be pointed out that these tables do not include the competences which, according to the survey, were not regarded as part of a 'widespread' body of knowledge in different roles, such as knowledge of information technology, applied mechanical and electronic engineering, knowledge of the working context. The picture that these tables show is revealing: 'today's' competences, and even more so 'tomorrow's', must be increasingly less sector-specific and ever more integrated and 'cross-sectoral', particularly in medium-to-high level roles.

The 'overall view' is provided mainly by the fact that the gradual spread of new technologies based on the computerisation of processes is linking and integrating various production sub-processes, requiring those performing the roles to have an ability to manage and control production quality from their own work position.

The Production Management function area is more complex in terms of knowledge and competences than the other function areas, partly because the number and diversification of roles are greater. The reports of the types of competence in this function area stress the growing need for:

- knowledge of logistic techniques, for production managers
- production coordination ability, for Numerical Control Machine Tool (NCMT) programmers
- knowledge of planning techniques, for NCMT operators
- knowledge of quality regulations and criteria, for production programmers
- knowledge of developments in materials, for R&D managers.

Table 8 below relates the occupational roles present in the area with the new competences they demand.

Table 8: Competences for occupational roles in the production management function area

Competences	Occupational roles
Knowledge of automated systems and of assembly line production system if the firm operates in that field	• Process and product manager • Software engineer • Orders manager • Department or workshop manager • Mechatronics engineer • Design engineer
Knowledge of production planning techniques	• NCMT programmer and operator • Production planner • Design engineer • Orders manager • Research and development manager • Information systems engineer
Knowledge of materials and the product	• NCMT programmer • Design engineer • Installer and tester • Tooling operator • Mechatronics engineer
Ability to interpret technical drawings	• NCMT manager and operator • Orders manager • Tooling operator • Mechatronics engineer
Knowledge of control instruments	• Department head • Assembler (and assembly manager) • Installer and tester
Knowledge of assembly techniques	• Assembler (and assembly manager) • Tooling operator
Knowledge of English	• Installer and tester

In the Quality Management function area, the interviewees mentioned three types of competences, as shown in Table 9.

Table 9: Competences for occupational roles in the Quality Management function area

Competences	Occupational roles
Knowledge of regulations	• Quality systems manager • Quality control engineer • Quality and safety manager
Knowledge of the process and product	• Quality systems manager • Quality control engineer • Quality and safety manager
Knowledge of control instruments and measuring techniques	• Quality control engineer

Reports on the competences required in the Logistics Management function area (Table 10) are confined to the Activity Areas associated in particular with the procurement of supplies and the movement of materials.

Table 10: Competences relating to occupational roles in the Logistics Management function area

Competences	Occupational roles
Ability to manage relations with suppliers	• Logistics manager • Procurement office manager
Knowledge of materials control techniques	• Logistics manager • Procurement office manager
Knowledge of materials movements techniques	• Logistics manager • Procurement office manager

The function area is revealed as being the area in which there is the greatest growth in competences. With regard to the body of competences currently required in those working in that area, Table 11 sets out the findings as reported by interviewees.

Table 11: Competences for occupational roles in the Commercial Management function area

Competences	Occupational roles
Knowledge of foreign languages	• Commercial manager Italy and abroad • Sales promotion • After-sales service engineer
Technical knowledge for contract management	• Commercial manager Italy and abroad • Commercial technician Italy and abroad
Knowledge of markets	• Commercial technician Italy and abroad • Sales promotion
Technical knowledge of sales	• Commercial technician Italy and abroad • Sales promotion
Knowledge of economics and finance	• Commercial manager Italy and abroad • Commercial technician Italy and abroad • Finance and control manager
Technical knowledge of product	• Commercial manager Italy and abroad • Sales promotion • After-sales service engineer
Knowledge of planning and control procedures	• Sales networks organiser • Finance and control manager

3.4 Trends among companies in their relations with the jobs market

The industrial zones in which Modena engineering firms are located are promoting the creation of a sort of network of enterprises. This foreshadows the possibility of setting up a 'virtual enterprise' in which each production structure, while preserving its own identity, cooperates with the others, making its own contribution to joint projects. This move is influencing jobs in the engineering industry: on the one hand, it is creating the need for a new strategic view; on the other, it calls for an updating of the body of technological competences and far greater emphasis on process and product quality.

This historic juncture for Modena enterprises is a transition phase in which technical and specialist competences and abilities - always the 'strength' of craftsmen in Modena engineering firms - need to evolve and be integrated with strategic/management type competences and abilities.
This 'transition' situation, which our analysis of function areas and individual Activity Areas has revealed even at the micro level, involves many aspects of the 'socio-production fabric', determining a need for competences and abilities to cope with the structural problems in the changing socio-production context.

In a summary breakdown of the most salient survey findings, the following companies were taken into consideration:

- companies strategically oriented towards change;
- companies not strategically oriented towards change.

3.5 The demand for vocational skills expressed by companies strategically oriented towards change

The structural characteristics of companies in this category are as follows:

- almost all are medium-sized or large;
- they tend to be structured in specific function areas;
- they are implementing (or propose to implement) strategies to predict market trends and developments;
- they tend to value and foster occupational skills, perceiving the value of the relationship between 'make or buy'.

The types of vocational skills they require are as follows:

a) Skills directed towards the management of innovatory function areas

Among managers in strategic-minded companies, one particular point is the significance of innovatory function areas such as Logistics, Quality and Marketing, and the stress on giving them 'operational visibility'. One of the strengths of such a development plan is the acquisition or training of human resources capable of:

- devising strategies in support of the function area;
- planning action;
- managing relationships with other operators in the same area;
- monitoring the outcome and improving the action plans.

These are complex occupational skills in which technical and specialist competences are combined with high-level cognitive and interpersonal skills. In most cases the skills are built up within the company workforce by a process of enrichment of competences.
In other cases, company management prefers to co-opt competent managers from outside.

b) Skills directed towards the management of integrated processes

It is appropriate to stress this type of occupational skill, even though in some ways it comes under the previous heading. The skills in question relate in particular technical and specialist resources.

Their importance is due to the fact that all production systems, even those broken down into function areas, have many links between functions and processes, to the point that any employee must be able to interact with those engaged in different but contiguous functions and processes. The main characteristic of such occupational skills consists of integrating the central core of competences and their 'typical contribution' with the occupational 'knowledge' required to produce an effective and efficient dialogue with other functions upstream and downstream in the process.

c) Occupational skills directed towards problem identification and solution

The 'transition' situation in which the branches analysed are now placed is forcing employers to place greater value, in the contributions of their employees, on that aspect of competence usually placed under the heading of 'creativity'.

3.6 The requirement for vocational skills expressed by companies not strategically oriented towards change

The structural characteristics of companies in this category are as follows:

- medium-sized or small companies;
- no precise differentiation of function areas can be identified in their structure;
- they tend to defend their own market 'niche';
- their entrepreneurial strategy is geared to the present;
- greater value is attached to the occupations required in obtaining products meeting the quality criteria accepted by the outside market, but especially the companies for which they work.

The occupational characteristics in the companies that come to this category are as follows:

a) Occupational skills directed towards multi-functionalism

This approach is needed because most of the human resources employed perform activities coming under the headings of different functions, while at the same time occupying function levels half way between management and specialist technician. The innovations introduced into the company culture, in particular in Logistics and Quality, cannot take shape in their own particular operating cores. The essential elements are incorporated into functions already operating within the companies. In other words, these are processes of 'enrichment' of vocational competences.

The tendency towards multi-functionalism is seen as a process which adds greatly to the complexity of the configurations in which occupational roles are 'designed' within production structures. Each situation is forced to expand its standard competences to meet the demands created by technology and the market. From the human resources, this calls for both high degree of technical competence and also a marked organisational mentality, openness to change and an ability to place a high value on experience-derived knowledge.

b) Occupational skills directed towards technical/specialist knowledge

This dimension of occupational skills is vital if companies of this type are to be able to retain their own market niches, which they secure by producing articles that match process and product quality specifications.

The sphere of operation for the occupational skills considered here is the implementation of procedures strictly confined to one segment of the process, and to monitoring those procedures. The gradual but now widespread introduction of computer technology calls for certain competences, basically mechanical engineering and applied information technology.

4. Introduction to the Vienna case

Over the years Vienna has lost its lead in Austrian industrial development. Its substantial industrial decline is essentially due to the outsourcing and relocation of its production sites. In particular, production with high labour costs has been transferred to neighbouring nations in Eastern Europe, mainly Hungary.

Over the past 15 years, the largest companies in the industrial system have closed down, at a rate of 1 in 5. The remaining companies have achieved what is a very high level of productivity by European standards.

Table 12: Evolution of industry in Vienna 1981-1994

Industry	*Labour force 1994*	*Labour force: % change from 1981 to 1994*	*Companies: % change from 1981 to 1994*	*Productivity: % change from 1981 to 1994*
Mechanical engineering*	7 391	- 21.4	- 12.9	+ 146.8
Vehicles	9 689	- 5.9	- 19.1	+ 172.0
Total for industry	84 336	- 22.2	- 35.2	+ 135.3

* except for electronic engineering on its own
Source: WIFO

The closure of companies has not been offset by the creation of new companies. Establishments with a high level of production left the city in about the 1980s. The high cost of an industrial location there and the growing shift of the Viennese economy towards service industries have contributed to this exodus.

Surveys on the Viennese industry in 1994 and 1995 have shown that even today about 15% of the companies are planning to relocate part or all of their production outside the Vienna area, and that about 50% plan to do so in the medium term.

In consequence, labour market experts predict a further loss of some 35 000 jobs in Austrian industry (-1.1%) by the year 2000, offset by a rise of about 0.6% (5 600 additional jobs) in high-tech industry.

In parallel with the loss of jobs in the engineering industry, there is a growing demand for improved skills. The reasons are to be found in the requirements brought about by rationalisation and ever greater production difficulties. Only a few companies in the sample launched substantial restructuring action before 1990.

The difficulties faced by Viennese industry have increased with the opening up to Eastern European economies, the European Common Market and the globalisation strategies of international engineering companies.

All the trends predicted originated from the marked reduction in industrial concerns in the Vienna area and more general difficulties in engineering production. Both these factors have less effect on the fairly large concerns in the Vienna area, but these too will have to face up to shortages of skilled manpower over the medium-term future.

4.1 The outlook for development and change in jobs in the engineering industry

In analysing the opinions expressed by national experts and company managers, seven trends emerged as affecting jobs:

1. the new 'Meister': manager and problem-solver
2. greater responsibility for skilled workers
3. dual occupations as an alternative to the division of labour
4. a rise in the level of formal qualifications
5. the shift from the functional approach to the product-oriented approach
6. formalised knowledge versus experience
7. globalisation strategy changing old job profiles and creating new profiles

This list is not exhaustive but at least it is an indication of which job profiles and which lines of education will be affected, and how. For a more detailed interpretation of the significance of and fallout from those trends as regards the composition of mainstream occupations, thought was given to the interaction of those trends in the following company situations:

- changes in responsibilities
- changes in qualifications
- changes in activities

- company areas concerned

Before going into the interactions in detail, it may be helpful to summarise a few aspects.
The first aspect, 'changes in responsibilities', describes the alternation in the level of responsibilities between existing jobs and newly introduced jobs.
The second, 'changes in the content of skills', shows the series of changes demanded in know-how, skills and training, both for existing and for new jobs.
The third aspect, 'changes in activities', shows the types of activities and work that are declining in percentage terms and in relevance, and those in which increases are predicted.
Lastly, 'company areas' show those workplace areas that are most affected by occupational trends.

4.2 The new Meister: manager and problem-solver

Table 13: Characteristics of 'the Meister'[1]

changes in responsibilities	changes in the content of skills	changes in activities	Activity Areas and the workplace areas concerned
• greater functional responsibility • reduces responsibility for the apportionment of work	• personnel management • administration • project management	• reduction in workforce monitoring activities • rise in problem solving activities • rise in work group coordination	• no area in particular
high impact	low impact	high impact	low impact

A twofold change can be observed in the role of 'Meister':

- less responsibility for the distribution of work to foremen and skilled workers;
- more tasks in the field of project management;
- there is less monitoring work, directed towards ensuring compliance with times and methods, whereas the new occupational competences will call for greater familiarity

[1] The Meister is the highest possible skill level in the dual system. Having passed the Chamber of Commerce official examination, a Meister is qualified to manage his area of specialisation within a company and to train apprentices. Typically, the Meister comes below the manager of a technical area in the workplace and the workshop foreman in the hierarchy of a company.

with costs, a detailed knowledge of the process and considerable know-how on logistics and personnel management.

The role of the Meister is also important as a production specialist and crisis manager as regards the processing and monitoring of plans; here he also has the status of a problem-solver and process coordinator, with wide specialist knowledge.

4.3 Greater responsibility for skilled workers

Table 14: Characteristics of skilled workers

changes in responsibilities	changes in the content of skills	Changes in activities	Activity Areas and the workplace areas concerned
• quality control in the working process • group work (for and in groups)	• knowledge of the production process • horizontal competences	• job rotation	• assembly • logistics
high impact	high impact	low impact	high impact

According to the companies in the sample, the key factors determining the success of engineering firms are strategic concentration on the core business, quality, the emphasis on customer service and speed.

Success cannot be achieved if the management level alone is involved: the product process needs to be optimised at shopfloor level by involving the production workers. In this context, skilled workers will assume greater responsibility for quality control, the apportionment of work, production output and the optimisation of certain production areas. These responsibilities call for competences such as a knowledge of the production process, the ability to work as part of a group, knowledge of costs, an entrepreneurial attitude and the ability to transfer knowledge. The changes will mainly affect the skilled workers in assembly and logistics areas, where quality control is an integral part of production. In discussing the new occupational demands, human resource officers have reported difficulties in training.

4.4 Dual occupation[2] as an alternative to the division of labour

Table 15: Nature of dual occupation

changes in responsibilities	changes in the content of skills	changes in activities	Activity Areas and the workplace areas concerned
• Those trained in dual occupations do not have substantial responsibilities in the initial phase	• rise in basic skills; • mixed technical disciplines	• increase in number of activities	• none in particular
low impact	high impact	high impact	low impact

Most of the companies surveyed try to maintain a separation between the mechanical and electronic engineering areas in production. A small but highly innovatory proportion of the firms expressed the need for a workforce able to work in both areas. The companies are training apprentices in dual occupations, mainly for the assembly workshop.

Even though this twofold job skilling has been introduced only recently into the dual training system, 20% of apprenticeship contracts in Viennese industry are of the 'dual occupation' type. Of the total of 366 'dual occupation' apprentices in the industry, however, 90% are trained in car-related jobs. Their apprenticeship combines 'automotive electrical engineering' with 'automotive mechanical engineering'.

The demand for a skilled labour force trained in two disciplines is perceived as being on the increase. Many interviewees said they had a demand for mechatronic apprentices (whose expertise covers both mechanical engineering and electronics). Only two companies explicitly stated that they would not take on apprentices, although they were prepared to recruit people who are already skilled.

Despite this trend, companies are not yet combining the mechanical engineering and electronic areas, although they welcome interdisciplinary skills and competences.

Almost all human resource managers indicated a growing need for skilled workers offering a combination of extended knowledge in specific fields of their occupation plus additional soft skills.

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[2] Dual occupations are to be found mainly in the car manufacturing industry, and are the prerequisite for certain types of structure based on project teams

4.5 Rise in the formal level of skills

Table 16: Nature of occupational resources

changes in responsibilities	changes in the content of skills	changes in activities	Activity Areas and workplace areas concerned
• increase in all vocational qualifications	• rise in levels of qualification (technical graduates are replacing technical diploma-holders)	• increase in production support activities (planning, plant management and maintenance)	• project management • technical product development • fabrication • process engineering • quality control
low impact	high impact	high impact	low impact

The above trends are apparent at every level of the company and in all activity areas. The level of qualification for first-time recruits is rising. The cause is the surplus of trained technicians emerging from vocational secondary education and the universities. Employers can draw on a large pool of highly qualified people: they can choose recruits for jobs and occupations for which less qualified people would normally be required.

Employers are using higher levels of qualifications for their new installations. Trainees who meet the requirements are put onto production work in a very short time and, because of their training, soon become over-skilled. Skilled workers in almost every company in the sample are replacing the unskilled workforce. Only two companies have reported a reversal in this trend, in that they are aiming to de-specialise their production.

Lastly, because of the growing specialisation and complexity of products and the production process (especially in areas such as fabrication and process engineering), there is a demand for greater basic knowledge. In these Activity Areas a graduate is more likely to be recruited than someone with a secondary education vocational or technical diploma. In the experts' opinions, this trend is the greatest challenge to the Austrian educational system.

4.6 Strategic and organisational changes

Table 17: From the functional to the product-oriented

changes in responsibilities	changes in the content of skills	changes in activities	Activity Areas and workplace areas concerned
• increase in individual responsibilities • increase in responsibility for keeping costs down and customer relations (for the engineer practitioner)	• greater product orientation • ability to work in an interdisciplinary project team	• greater service orientation • closer links between production and administration	• logistics
high impact	high impact	high impact	high impact

'Lean production' and group-oriented production are terms that have been used in the literature since the early 1980s. Nevertheless, only a few of the companies in the sample embarked on any form of restructuring before 1990. Reorganisation to shift the emphasis is an incentive to form interdisciplinary project groups. The greatest potential for optimising the workplace lies in logistics, process flows and new customer-directed structures.

In this context there is scope for group working, flexible production and project management. This development generates a need for a labour force capable of understanding the production process in that it is closely involved in the restructuring measures. In consequence, what is expected is a growing preparedness to take an active part in continuing training. Employers feel the need to set up training measures to adapt workers' competences to change. There is a particular need to plan competence and knowledge at every level of the hierarchy. Pending higher rates of job rotation, once again there is a demand for 'soft skills', for example the ability to work on one's own initiative. Organisational abilities and communications skills are becoming essential competences for skilled workers as well.

4.7 Mix of skills and experience

Table 18: Formalised knowledge versus experience

changes in responsibilities	changes in the content of skills	changes in activities	Activity Areas and the workplace areas concerned
• the relationship between formal knowledge and experience is having a variable effect on changes in responsibilities	• analytical and conceptual ability at every level of production • greater scientific knowledge	• closer integration of knowledge and experience	• all workplace areas
low impact	high impact	high impact	high impact

The steady rise in the complexity of production methods and instruments calls for greater formal knowledge. The workforce is increasingly being called upon to use analytical and conceptual thinking to cope with complexity.

This is a general trend, affecting every area of the workplace. Furthermore, in planning and programming areas, product knowledge and work experience are very important requirements. The links between formal knowledge and experience may have a varying effect on changes in responsibilities.

The greatest demand is for expert skilled workers with a good level of formal training.

4.8 The changes in former job profiles and the creation of new profiles brought about by globalisation strategy

Table 19: Characteristics of the new job profiles

changes in responsibilities	changes in the content of skills	changes in activities	Activity Areas and the workplace areas concerned
• greater responsibility for customer contacts at every level of the hierarchy	• new jobs combining project management with assembly work	• fewer activities in labour-intensive production areas	• none in particular
high impact	high impact	high impact	low impact

The growing focus on international markets in the Vienna engineering industry has made export growth a central issue.
Engineering is becoming a competitive factor, and the outsourcing of labour-intensive production units is creating new job profiles. The '*Inbetriebsetzer*', a growth occupation on the labour market, is a job profile sought by many export-oriented firms. The *Inbetriebsetzer* is responsible for operational start-up and commissioning plants both inside the country and abroad. This person must have very broad product knowledge, the ability to communicate and quality control skills. The level of training required is on a par with that of the Meister. This occupation is a major objective in possible continuing training channels for highly motivated and expert skilled workers.

Most international concerns with production units in the area of Vienna are developing a specific form of organisational restructuring: what are known as 'competence centres'. People with support jobs (assistants) become responsible for the production development of a line of products (= competence centre).

On the one hand, this increases the demand for an optimum knowledge of production processes and engineering processes for the competence centres; on the other hand, the growing number of international contacts calls for a sound technical background, the ability to communicate and a service-oriented mentality. The latter is particularly necessary for technical consultancy work. The strategy of improving services for the various firms that make extensive use of outsourcing calls for similar competences for the transfer of know-how to remote outsourced production locations.

4.9 Additional findings

Most of the trends indicated by the national experts were confirmed during the survey in the companies. Nevertheless, the human resource managers expressed different views on some of these trends.

1. The national experts predict a shortfall of workers with the characteristics now in demand over the next three to five years. On the other hand, certain human resource managers in the workplace state that these types of workers have existed in the workplace for some time now and have been formed through internal work experience.

2. According to the 'workplace' survey findings, job profiles are not merging, as predicted by the experts, although the field of activities for specific profiles is tending to expand, especially in assembly work.

3. In the opinion of the company interviewees, the work group-based type of organisation is not generating a need for 'multi-skilled workers', as asserted by the national experts.

4. Many national experts have pointed to a future demand for additional education and training in mathematics and mechanical engineering, whereas the in-company interviewees expressed two different opinions. Some criticised the ever more extensive lack of basic mathematical skills among young people entering the dual system in technical areas, while others call for better basic education and training rather than further mathematical skills.

5. Lastly, the replacement of engineers in the technical and sales areas by medium-level technicians described by the national experts has not been observed within the workplace.

Part III

Trends in occupations in the engineering industry in Modena and Vienna: conclusions

5. The problems

Even though there were differences in the approach and implementation of the two parallel surveys (due to the different procedures adopted in the two production contexts), they showed that the demand for qualifications in Austria differs in pattern from the demand in Italy.

It is not easy to make an exhaustive comparison between the findings of the two surveys, for the following reasons:

- the objectives pursued in the two research projects were not identical;
- the data on the legislative framework and nature of the industry in the two countries only partly coincide;
- the information acquired in the two surveys, while relating to the same sphere of vocational changes, differs in its specific nature and level of detail;
- the two analytical routes were different;
- the two sets of survey findings lend themselves only in part to comparisons.

Table A summarises the characteristics of the two national surveys, and the procedures used to conduct them. The subject covered by both surveys was that of occupations in the engineering industry. The research conducted in Vienna was designed to respond to the demand and the need for information with a view to providing guidelines for, and preparing a review of, the federal vocational and technical education system, particularly as regards those new vocational contents that might be helpful in planning the provision of training. The Modena survey had a twofold purpose: to find out about new vocational contents and competences that would help in directing regional policies on training, and to gather facts and figures for use in policies on active labour-market management.

Both goals were based on the requirements for occupations and competences expressed by local engineering firms.
Although there were a few similarities between the goals of the two surveys, the differences in methodological approach were considerable. The IWI preferred to adopt a purely qualitative research technique in order to achieve its objective: the incremental approach. This was a sort of Delphi method, with step-by-step verification by new experts. Isfol and the Commune of Modena, on the other hand, conducted a qualitative/quantitative analysis of a sample of 90 firms, together with interviews – both before and after the field research phase – with experts from the social partners, the training system and engineering industry operators. As will be noted from Table A, there were also differences in the end results, in particular:

- the Austrian survey produced material and information that could be used to verify the degree to which the existing vocational skills in the engineering industry are aligned with those being considered in the federal vocational and technical education system. This information can be used in support of further planning;

- the Modena survey was used to produce a list of typical engineering industry occupations that are in demand on the local market. The companies gave their views on each occupation and the employment prospects and strategic value of these resources within the organisation. An analysis of those occupations also helped to identify new contents and competences that can be used in setting up vocational training measures.

Table A: Characteristics of the local surveys

	AUSTRIA (Vienna)	**ITALY (Modena)**
Objectives	Define the future demand for vocational skills	Define the demand for occupations and competences
Methodology	Qualitative and incremental analysis: • interviews with national experts from industry and education • qualitative interviews with human resource managers from 50 engineering firms: - metal engineering - car manufacturers • company case histories • focus groups	Qualitative and quantitative analysis: • qualitative interviews with experts on the engineering industry labour-market • quantitative survey on a sample of 90 engineering firms in the following branches: - agricultural machinery - mechanical fabrication - sports cars • focus groups
Typology of findings	• Verification of the degree of matching between vocational skills already existing in the engineering industry and those envisaged in the federal vocational and technical training system • Information to support planning of the education system	• List of typical engineering industry occupations required on the Modena market • Indication of the occupational requirement for typical practitioners • Information on occupations and occupational competences that would help in planning good vocational training measures

Despite the basic differences in the survey approach, the two research teams made efforts to optimise their national work through the parallel development of their research activities in the two contexts and by accounting for the times taken to carry out the two surveys. An exchange of information in the course of the research was also planned.

Table B shows the parallel conduct of the surveys, showing that each survey was broken down into three phases:

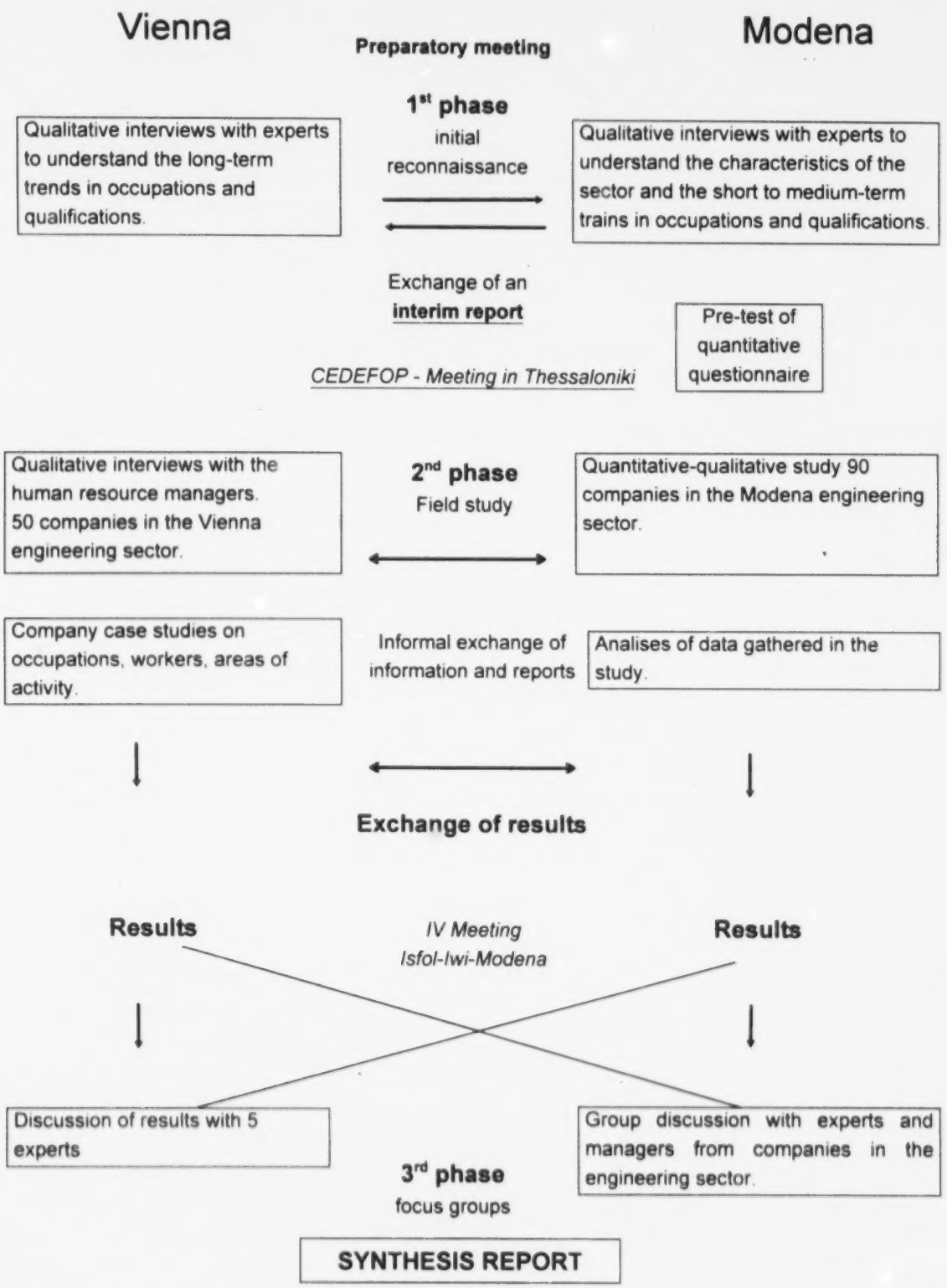
first phase: preparatory – meetings with interviewees with insider knowledge to identify the occupational trends in the industry;

second phase: implementation – gathering facts and figures on occupational skills in the engineering industry;

third phase: verification – discussion and validation of the findings acquired in focus groups.

The two work groups kept in constant contact by exchanging opinions and documents via e-mail, fax and telephone. They also arranged formal working meetings at the end of each phase.

Table B: History of the local surveys


Vienna
Modena
Preparatory meeting
1st phase
initial reconnaissance
Qualitative interviews with experts to understand the long-term trends in occupations and qualifications.
Qualitative interviews with experts to understand the characteristics of the sector and the short to medium-term trains in occupations and qualifications.
Exchange of an interim report
Pre-test of quantitative questionnaire
CEDEFOP - Meeting in Thessaloniki
2nd phase
Field study
Qualitative interviews with the human resource managers. 50 companies in the Vienna engineering sector.
Quantitative-qualitative study 90 companies in the Modena engineering sector.
Company case studies on occupations, workers, areas of activity.
Informal exchange of information and reports
Analises of data gathered in the study.
Exchange of results
Results
IV Meeting
Isfol-Iwi-Modena
Results
Discussion of results with 5 experts
Group discussion with experts and managers from companies in the engineering sector.
3rd phase
focus groups
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Despite this optimisation of the procedural route, in the light of the factors described above it will be realised how hard it was to arrive at a searching and accurate comparative study of the two experiments. Nevertheless, the analysis of the findings allows us to identify three areas of convergence:

- the characteristics of the engineering industry in two different contexts;
- the main occupational trends;
- changes in competences.

Through parallel processing of the findings from the two surveys, certain essential conclusions were then drawn.

6. Conclusions

6.1 Background

The previous sections outline the main features of the engineering industry in the Vienna and Modena production contexts. In this section we shall provide a few background facts for the two situations surveyed.

We should point out that the sub-branches covered by the two national surveys were not exactly the same. The reference universe for the research conducted by IWI was engineering production and car manufacturing, whereas the universe in the Modena area was that of mechanical processing, agricultural machinery and sports cars.

The size of the sector recorded in the statistics for 1991 and 1994 (the latest figures available) – see Table C – shows that there has been a sharp drop in the number of firms in the Viennese industrial sector. This has led to a marked fall in employment due to the relocation of production plants and recourse to outsourcing. These strategies were adopted in an attempt to cope with the massive crisis affecting the industry, the later result of which was to push production towards globalisation.

Table C: Trends in the engineering industry in Vienna (1991-1994)

AUSTRIA (Vienna)			
mechanical production and vehicles			
1991		1994	
N° firms	N° employees	N° firms	N° employees
1 080	25 822	145	12 130 (approximately)

Source: OSTAT

In the production district in Modena, one that characteristically contains many small and medium-sized firms operating in close synergy in a sort of 'virtual' firm, the comparison with the available statistics for 1991 and 1996 – see Table D – shows a slight drop in employees in an entrepreneurial context in mild decline. The small variation in the figures for 1991 and 1996 conceals the radical changes that have been taken place in the industry – although these were reported by the interviewees – in the form of:

- a marked development in technological innovation
- considerably greater flexibility in company organisation

- the setting up of networks of engineering firms

This gives grounds for the belief that, despite the crisis that has hit the economy, Modena can rely on certain strengths, perhaps due to the drive towards innovation and the organisational flexibility characteristic of the industrial pattern in this area.

Table D: Trends in the engineering industry in Modena (1991-1996)

ITALY (Modena)			
mechanical fabrication, agricultural machinery and sports cars			
1991		**1996**	
N° firms	N° employees	N° firms	N° employees
154	8 447	136	8 104

Source: Modena Chamber of Commerce

From the above it is evident that there are marked features peculiar to the two contexts taken into consideration. Even so, both production areas have a common commitments to exports: the percentage exported is 60% among the Viennese industrial concerns and 56% in Modena.

6.2 Occupational trends and competences

Despite the marked diversity of the two production contexts, the engineering industries in Modena and Vienna are going through a transition phase in which, although the pattern differs somewhat, competences and technical and specialist skills are being integrated with strategic and managerial competences and skills.

The typical nature of the two production models – with Modena firms tending to come together on the production level in a networked system within which they collaborate on joint projects, whereas firms in Vienna resort to outsourcing and relocation has led to job losses in the engineering industry in both cities (very substantial in the case of Vienna), as well as considerable changes in occupations and therefore a greater demand for skills. The following table (Table E) summarises the seven main occupational trends that became apparent from the two surveys.

Table E: Characteristics of trends in occupations

AUSTRIA (Vienna)	ITALY (Modena)
1. development of problem solving	8. flexible specialisation
2. increase in responsibilities	9. management of innovatory function areas
3. dual occupation	10. management of integrated processes
4. rise in the level of skills	11. problem discovery and solving
5. greater product orientation	12. multi-functionality
6. formalised knowledge versus experience	13. rise in technical and specialist knowledge
7. acquisition of globalisation strategy	14. greater quality orientation

A parallel study of the trends recorded in the two countries points to similarities in the requirements for occupational skills and competences of workers in the engineering industries there. Setting aside the features peculiar to the two production contexts – the globalisation strategy in the Vienna engineering industry (see Table E, line 7) and the production flexibility strategy typical of the district of Modena (see E, 8) – what they have in common is that they are responses to a challenge: the precarious nature of jobs because of the growing internationalisation of the engineering industry and the processes of reorganisation of management structures that this entails. The need for flexibility, knowing how to cope with critical situations, a greater sense of responsibility are a shared experience for workers in Modena and Vienna on their path to the acquisition and retention of jobs.

In order to achieve this objective, as shown by Table E, it is important:

- to add to technical and specialist knowledge, as found in Modena (13) and in Vienna, where a higher level of basic qualifications is being demanded (line 4);
- to combine technical knowledge with cognitive and interpersonal abilities in order to cope with integrated processes in Modena firms (10) and within the company globalisation strategies adopted by firms in Vienna (7);
- to improve knowledge of the production process at every level in order to improve quality in the context of Modena (14) and the shift to product orientation characteristic of firms in Vienna (5);
- to interact and act in roles in different functions and processes, as part of the multi-functionality demanded of workers in Modena (12), which could be compared to the dual occupations required of engineering workers in Vienna (3).

- to be capable of discerning and solving problems, as the Modena workers are required to do (11) as well as the Meister in Vienna (line 1).

These are the closest analogies in terms of occupational trends in the two production contexts. The labour market in both Modena and Vienna calls for workers with higher basic skills and more detailed technical and specialist knowledge who at the same time are developing horizontal competences or soft skills, as defined in the Austrian research, so that they can improve communications and interpersonal relationships within firms and with customers.

In spite of the similarities in the reported vocational competences required of workers in Vienna and Modena, the approach adopted by the two national surveys rules out a point-by-point comparison of the competences for individual occupational roles, since the depth of analysis adopted in these two surveys was not the same.

Table F is an attempt to provide a general summary of the vocational competences, grouped by performance-related competences, social competences and personal competences. The latter two types are horizontal skills affecting all those who work in the engineering industry.

Table F: Comparison of the new competences in two local contexts

Competences	AUSTRIA (Vienna)	ITALY (Modena)
Performance-linked competences	• integration of mechanical engineering and applied informatics types of competence • interdisciplinary competences • knowledge of products and processes • integration of work experience	• integration of mechanical engineering and applied informatics types of competence • integration of technical and specialist knowledge with cognitive and interpersonal skills • knowledge of production process dynamics • making use of work experience to become multi-skilled
Social competences	• ability to communicate • work group orientation • management of interpersonal relationships	• ability to communicate • ability to interact with other roles and/or functions • interpersonal skills
Personal competences	• ability to work independently • analytical and conceptual skills • problem solving skills • flexibility	• ability to work independently • problem solving abilities • flexibility • analytical ability

As is evident from Table F, the performance-linked competences noted in the two countries refer to occupational skills which, compared with the past, call for a higher level of basic knowledge, on which is built up more detailed knowledge: technical and specialist knowledge, and process and product knowledge that promotes the kind of job rotation typically found when work is oriented towards projects and working as a team. For example, for roles entailing responsibility, in both the countries a detailed knowledge of project management is regarded as necessary.

The new organisational structures being consolidated in both the contexts surveyed require everyone in the workplace to have social competences associated with the ability to communicate and interact with people inside and outside that workplace. One reason is that the demarcation lines between production and other company spheres are becoming blurred, and production is ever more customer-oriented. The ability to interact and interpersonal skills, which promote group work, are vital competences in production contexts increasingly based on project teams.

This new production framework, then, calls for people having personal competences enabling them to work independently within groups and to have a high level of analytical and conceptual abilities which, combined with flexibility, will enable them to cope with critical situations in the complex, integrated future.

CEDEFOP — European Centre for the Development of Vocational Training

The requirement for vocational skills in the engineering industry in the areas of Modena and Vienna

Synthesis report

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The requirement for vocational skills in the engineering industry in the areas of Modena and Vienna

Synthesis report

This study was conducted as one of the initiatives supported by Ciretoq — the network on trends in the development of occupations and qualifications — which attached particular importance to analysis and prediction of occupational requirements and the dynamics of job skills.

The study required the coordinated carrying-out of two local surveys — in Vienna and Modena — to analyse the vocational requirements in the engineering sector.

The Viennese survey was designed to study changes in occupations occurring across the engineering industry. The research conducted in Modena was aimed at identifying the occupational profiles most in demand on the labour market and interpreting the trends in employment, and analysing changes, current and future, in occupational profiles, with specific reference to three branches: mechanical processing, agricultural machinery and tractors, and sports cars.

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